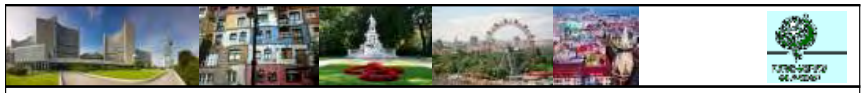
12th Workshop of the IOBC Global Working Group on Arthropod Mass Rearing and Quality Control

19-22 October 2010
Vienna, Austria

Development of quality control procedures for Lepidoptera

James E. Carpenter, USDA-ARS
Greg Simmons, USDA-APHIS
Tom Blomefield, ARC-South Africa
Stephen Hight, USDA-ARS



IAEA Consultants Group Meeting on

"Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control"

December 3-7, 2007
Vienna, Austria

Consultants:	Joint FAO/IAEA, IPC sub-programme Staff
Greg Simmons	Including:
Max Suckling	Marc Vreysen
Matthew Addison	V.A. Dyck
Jim Carpenter	

The work product of this Consultant's meeting was published as an invited review article in a special issue of the Journal of Applied Entomology (2010) which highlighted the progress of an FAO/IAEA Coordinated Research Project on Improvement of Codling Moth SIT to Facilitate Expansion of Field Application

G. S. Simmons, D. M. Suckling, J. E. Carpenter, M. F. Addison, V. A. Dyck, and M. J. B. Vreysen. 2009. Improved quality management to enhance the efficacy of the sterile insect technique for lepidopteran pests. Journal of Applied Entomology 134 (3): 261-273.

IAEA Initiated a new Co-ordinated Research Project (CRP) on "Increasing the Efficiency of Lepidoptera SIT by Enhanced Quality Control" in 2009

First Research Co-ordination Meeting within the FAO/IAEA Coordinated Research Programme was held in Christchurch, New Zealand from 27 April to 1 May 2009.

First Research Co-ordination Meeting (RCM) within the FAO/IAEA Coordinated Research Programme was held in Christchurch, New Zealand from 27 April to 1 May 2009.

For this CRP 3 key areas were identified where research could be conducted to improve the quality management of Lepidoptera for use in SIT programmes:

a) identifying and characterizing factors and variables that affect quality and field performance of released moths;
b) developing and improving tools and methods to assess, predict and enhance the field performance of released moths based on insect quality;
c) developing new and improved methods for enhancing rearing systems, and facilitating the selection for performance and fitness traits that improve colony establishment, refurbishment and production, and the field performance of released moths.

First Research Co-ordination Meeting
Christchurch, New Zealand

This RCM was attended by 15 CRP participants coming from 13 countries (Argentina, Austria, Australia, China, India, Israel, Malaysia, Mexico, New Zealand, Syria, Tunisia, South Africa, and USA). The meeting was likewise attended by several observers from New Zealand Institute for Plant and Food Research

The Second RCM will be held in Stellenbosch, South Africa, November 2010

As part of this CRP, we have been examining factors and variables that affect quality and field performance of released moths, and we are working to develop methods to assess, predict and enhance the field performance of released moths.

For this presentation, the first example is work on the codling moth, a pest of pome fruit.

Two-year study: moths reared and irradiated in British Columbia were commercially air-freighted in cold boxes to Stellenbosch, South Africa:

Year 1 - 23 consignments from which moths were released in commercial orchard

Year 2 – 7 consignments from which moths were released in commercial orchard and 12 consignments from which moths were released in a research farm

Laboratory bioassays were conducted for each consignment

Long distance air-freighting | **Mating Cages** | **Release-Recapture**

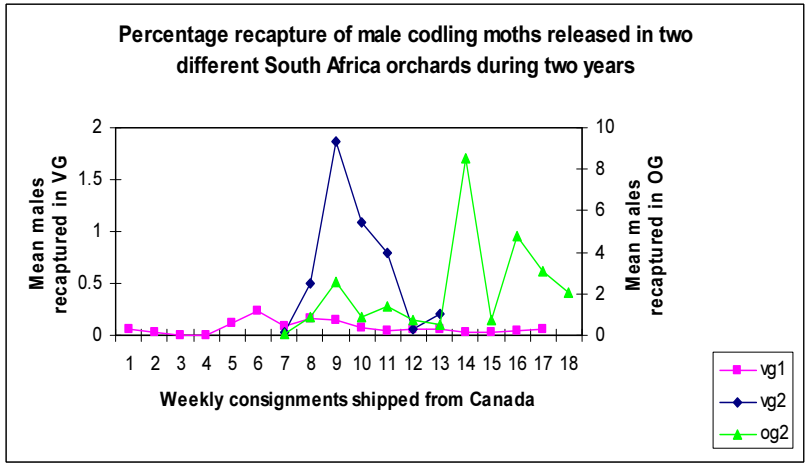
A dataset was constructed which included variables associated with factors linked to the insectary, the air-freighting, and the field; and variables associated with laboratory and field bioassays.

Data analysis included Stepwise Regression Analysis (Max R^2 method) to construct the best 1- 6 variable model to predict moth quality and field performance.

Variables included in dataset:

Male and female weight and longevity
% mated females upon arrival, after 24h and 48h
% increase in mating after 24 and 48h
Flightability (flight cylinders)
Transit time, maximum & minimum temperature
Transit time temperature < 0°C
Consignment arrival date and time
Petri dishes & moths/dish (males & females)

Year
Release farm site
6PM temperature
8PM temperature
10PM temperature
males released
% recapture



Year 1 - Farm Site Vg

Dependent Variable: **%Recapture**
R-Square = 0.7101
Pr > F = 0.0093
Model =

Variable	Parameter Estimate	F Value	Pr > F
Intercept	-1.05384	2.84	0.1230
♂**Longevity**	0.02140	2.70	0.1317
Transit Time	0.02014	4.02	0.0729
Max Transit Temp	0.00583	2.99	0.1146
%♂ in Consignment	-0.00692	14.01	0.0038

Year 2 - Farm Site Vg

Dependent Variable: **%Recapture**
R-Square = 0. 9805
Pr > F = 0.0195
Model =

Variable	Parameter Estimate	F Value	Pr > F
Intercept	3.52454	139.69	0.0071
Time Temperature<0	0.09803	9.11	0.0945
Arrival Date	-0.57192	79.08	0.0124

Year 2 - Farm Site Og

Dependent Variable: **%Recapture**
R-Square = 0.9417
Pr > F = 0.0004
Model =

Variable	Parameter Estimate	F Value	Pr > F
Intercept	-11.95940	27.16	0.0020
%Mated@24h	0.09422	29.25	0.0017
Time Temperature<0	0.36296	41.02	0.0007
Max_Temp_Day2	0.21414	15.29	0.0079

Cactoblastis cactorum:

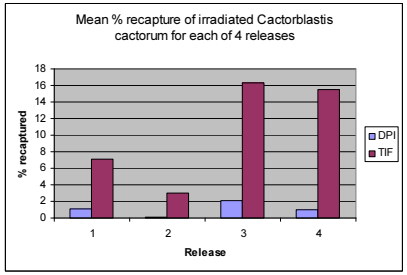
Successful biological control agent for weedy *Opuntia* in many parts of the world

Formidable invasive pest of native *Opuntia* in North America

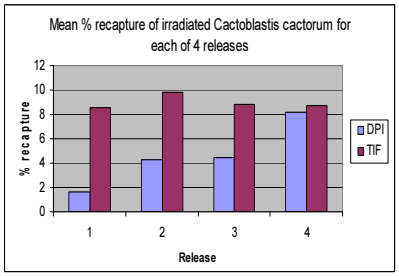
A combination of control tactics, including the SIT, has been used effectively to eradicate *Cactoblastis cactorum* incursions in Mexico and to significantly reduce populations along the U.S. Gulf coast.

Release /Recapture study

Trial 1



Trial 2



Cactoblastis cactorum

Dependent Variable: **% Recapture**

---------- Trial=1 ----------

R-Square = 0.9809 Pr > F= 0.0470

Variable	Parameter Estimate	F Value	Pr > F
Intercept	-43.93437	14.60	0.0622
Pre-Mated (%)	-0.83455	39.02	0.0247
%Mated	-0.96079	33.18	0.0288
♀Longevity	8.78878	11.35	0.0780
% flight@24h	0.13089	35.66	0.0269

---------- Trial=2 ----------

R-Square = 0.9985 Pr > F= 0.0001

Variable	Parameter Estimate	F Value	Pr > F
Intercept	72.24186	880.92	0.0001
♀Longevity	-6.43063	990.87	0.0001
%Flight@48h	-0.08634	210.00	0.0007
♂ Weight	453.54122	425.39	0.0002
♀Weight	-413.84045	551.27	0.0002

Summary

- The new IAEA CRP will facilitate the advancement of quality control procedures for Lepidoptera

- Detailed datasets and Stepwise Regression Analysis can be used to develop predictive models and to provide a feedback mechanism for monitoring and improving sterile moth performance in the field

- Our initial research approach to monitor and assess variables that are linked to moth quality has already led to improved sterile moth performance in an operational program